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IS 7204-2 (1980): Stabilized power supplies dc output, Part 2: Rating and performance [ETD 31: Power Electronics]

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"RE-AFFIRMED 1996"  
IS : 7204 ( Part II ) - 1980

*Indian Standard*  
SPECIFICATION FOR  
STABILIZED POWER SUPPLIES, DC OUTPUT  
**PART II RATING AND PERFORMANCE**

UDC 621.311.6.024



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INDIAN STANDARDS INSTITUTION  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

G14

Price Rs 7.00

December 1980

# Indian Standard

## SPECIFICATION FOR STABILIZED POWER SUPPLIES, DC OUTPUT

### PART II RATING AND PERFORMANCE

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*Indian Standard*SPECIFICATION FOR  
STABILIZED POWER SUPPLIES, DC OUTPUT

## PART II RATING AND PERFORMANCE

## 0. FOREWORD

**0.1** This Indian Standard ( Part II ) was adopted by the Indian Standards Institution on 6 June 1980, after the draft finalized by the Power Convertors Sectional Committee had been approved by the Electrotechnical Division Council.

**0.2** This standard for stabilized power supplies is being prepared in four parts. This part covers rating and performance only. The other parts are as follows:

Part I Terms and definitions,

Part III Radio frequency interference tests, and

Part IV Tests other than radio frequency interference.

**0.3** In preparation of this standard, assistance has been derived from IEC Pub 478-2 ( 1975 ) 'Stabilized power supplies, dc output Part 2 : Rating and performance', issued by the International Electrotechnical Commission.

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## 1. SCOPE

**1.1** This standard ( Part II ) covers rating and performance applicable to stabilized power supplies designed to supply dc power from an ac or dc source for applications such as computers, communication, laboratories and industry.

**1.2** Calibrated stabilized power supplies for electrical measurement purposes are excluded.

## 2. TERMINOLOGY

**2.1** For the purpose of this standard, the terms and definitions given in IS : 7204 ( Part I )-1974\*, shall apply.

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\*Specification for stabilized power supplies, dc output : Part I Terms and definitions.

### 3. PERFORMANCE REQUIREMENTS

**3.1** The performance of a stabilized power supply shall comply with the specified values of the quantities listed in the manufacturers' data sheet or other documents mutually agreed by the manufacturer and the user.

**3.2 Operating Conditions** — Different performance ratings are valid under different operating conditions. These conditions are defined by different sets of values or ranges of values of the influence quantities and the stabilized output quantity. The following sub-clauses define three conditions.

**3.2.1 Reference Conditions** — Reference conditions are defined by values or ranges of values for the influence quantities and the stabilized output quantity which reflect typical operating conditions.

**3.2.1.1** Reference conditions serve:

- a) as conditions under which the intrinsic error may be determined (Tolerance I), and
- b) as specific conditions for the validity of performance requirements (Tolerance G).

**3.2.1.2** The widened tolerance which typically apply to case of **3.2.1.1** (b) relate to the initial setting of the quantities and may not be construed to denote permissible changes during the measurement.

**3.2.2 Rated Conditions** — Rated conditions are defined by simultaneously applicable rated ranges of values for the influence quantities and the stabilized output quantity over which the stabilized power supply is intended to operate and remain within its performance requirements.

**3.2.3 Limit Conditions** — Limit conditions are defined by a limiting range of values for one influence quantity and rated ranges of values for the other influence quantities and the stabilized output quantity which can be tolerated by the stabilized power supply without damage, but within which it does not necessarily meet all performance requirements.

**3.2.3.1** If limiting ranges of values are indicated for more than one influence quantity, they shall be permitted only on an individual basis, unless otherwise stated.

**3.3 Required Rating Data** — Nominal values or rated ranges for the quantities listed in Table 1 are required rating data.

**3.3.1** Table 1 indicates further:

- a) which value is to serve as reference, and which tolerances apply thereto, depending on the intention for which reference conditions are established; and
- b) which ratings may be assumed to constitute rated conditions in the absence of an explicit statement.

**3.3.2** Rated conditions as listed in Table 1 are required ratings.

**TABLE 1 REQUIRED RATING DATA**

( Clauses 3.3, 3.3.1, 3.3.2 and 3.5 )

SL No.	INFLUENCE QUANTITY	REFERENCE CONDITIONS			RATED CONDI- TIONS RATED	RE- MARKS
		Reference Values	Tolerance	I*      G†		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	Source voltage	Nominal value	$\pm 1\%$	$\pm 3\%$	AC input : 90% to 100% of nominal value DC input : 85% to 115% of nominal value	See Note
2.	Source frequency	Nominal value	$\pm 1\%$	$\pm 1\%$	97% to 103% of nominal value	See Note
3.	Output current ( constant voltage power supplies )	Nominal value or maximum value of rated range	$\pm 1\%$	$\pm 2\%$	0% to 100% of nominal value or rated range	See Note
4.	Output voltage ( constant current power supplies )	Nominal value or maximum value of rated range	$\pm 1\%$	$\pm 2\%$	0% to 100% of nominal value or rated range	See Note
5.	Ambient tempera- ture	27°C	$\pm 1^\circ\text{C}$	$\pm 3^\circ\text{C}$	0°C to 45°C	See Note
6.	Cooling medium temperature when different from ambient temperature	Nominal value	$\pm 3^\circ\text{C}$	$\pm 5^\circ\text{C}$	Air cooling: up to 35°C	
7.	Cooling medium flow volume ( forced cooling )	Nominal value	$\pm 10\%$	$+50\%$ $-10\%$	Down to 90% of nominal value	
8.	Stabilized output quantity					
a)	Output voltage ( constant voltage power supplies )	Nominal value or maximum value of rated range	Not applicable	$\pm 2\%$	0% to 100% of nominal value or rated range	
b)	Output current ( constant current power supplies )	Nominal value or maximum value of rated range	Not applicable	$\pm 2\%$	0% to 100% of nominal value or rated range	

NOTE — The rated conditions and ranges of values other than those specified in col 6 may be specified if agreed between the manufacturer and the user.

\*Tolerance I is applicable for the determination of intrinsic error.

†Tolerance G is applicable in general for the validity of performance requirements.

**3.4 Optional Rating Data** — The additional influence quantities listed in Table 2 may be of functional importance in unusual environments or when a stabilised power supply is particularly susceptible to them. The reference values and ratings recommended for this case are given in Table 2; they constitute optional rating data.

TABLE 2 OPTIONAL RATING DATA

SL No.	INFLUENCE QUANTITY	REFERENCE CONDITIONS (See 3.2.1)			RATED CONDI- TIONS RATED RANGES OF VALUES
		Reference Value	Tolerance		
			I*	G†	
(1)	(2)	(3)	(4)	(5)	(6)
1.	Total source voltage distortion	AC input: relative harmonic content of 3% DC input: peak-to-peak ripple of 10%	+ 0 - 3	+ 3 - 3	AC input: total harmonic content up to 10% DC input: peak-to-peak ripple up to 20%
			percentage points	percentage points	
2.	Voltage unbalance	1%	—	—	3%
3.	Relative humidity	65%	± 15	+ 20 to - 40	20% to 95%
4.	Barometric pressure	101 kPa	± 5 kPa	+ 5 kPa - 15 kPa	86 kPa to 106 kPa
5.	Magnetic field strength at source-frequency	Up to 1 A/m	—	—	0 A/m to 100 A/m
6.	Vibration	Under consideration	—	—	—
7.	Shock: product of peak acceleration and duration of shock pulse	0.1 m/s	—	—	0.2 m/s
8.	Output ripple	The requirements shall be agreed between the manufacturer and the user			

\*Tolerance I is applicable for determination of intrinsic error.

†Tolerance G is applicable in general for the validity of performance requirements.

**3.5 Limit Influence Ratings** — If limiting ranges of values are indicated for influence quantities in Tables 1 and 2, those performance ratings which are no longer met shall be specified.

**3.6 Performance Ratings** — Performance ratings are listed in Tables 3 to 8. In specifying the performance of a power supply, a distinction is made between mandatory performance ratings and others where performance ratings are merely recommended; mandatory indications are in italic type in Tables 3 to 8.

## 4. EARTHING

**4.1** In each unit, two power earth terminals shall be provided in effective electrical contact with cubicle frame work. All metal parts of the components of the unit which do not carry current shall be bonded thereto. The nominal cross-sectional area of the earth continuity conductor not contained within the cable shall be at least 1·6 mm diameter approximately and not more than 5 mm diameter and in general not less than one-half that of each of the current carrying conductors to be protected. The terminals shall be suitable for terminating earth conductors.

## 5. PHYSICAL CHARACTERISTICS

### 5.1 Dimension

**5.1.1 Overall Dimensions** — Overall dimensions shall include all parts that are attached to the power supply and are required for its operation such as control knobs, terminals, bushings, feet, etc, including minimum bend radius of source cords.

**5.1.2 Order of Dimensions** — Dimensions should be listed in the following order: height × width × depth.

**5.1.3 Height** — Height is the overall dimension in the vertical direction of normal usage.

**5.1.4 Width** — Width is the overall horizontal dimension parallel to the surface which is intended to be accessible during operation or for setting.

**5.1.5 Depth** — Depth is the overall horizontal dimension perpendicular to the plane described by height and width.

**5.1.6 Internal Depth** — In the case of rack-mounted power supplies, an additional dimension is required, 'internal depth', which is that dimension in the same direction of depth, but measured from the mounting surface.

**5.1.7 Clearance Dimensions** — If clearance is required for proper operation of the power supply, the dimensions of the space to be available shall be listed in the same order as the overall dimensions.

**TABLE 3 PERFORMANCE RATINGS — QUANTITIES RELATED TO SOURCE**

(Clause 3.6)

SL No.	SPECIFIED QUANTITY	SPECIFIED DATA	APPLICABLE CONDITIONS	REFERENCE	
				Test [ Clause in IS : 7204 ( Part IV )- 1980* ]	Definition [ Clause in IS : 7204 ( Part I )- 1974† ]
(1)	(2)	(3)	(4)	(5)	(6)
1.	Inrush current	Maximum instantaneous value, typical duration of transient	Rated conditions; maximum instantaneous peak source voltage drop to less than 10% of rated peak value	14	2.10
∞	2. Rated source current	Typical rms value for ac typical mean value for dc	Rated conditions	14	—
3.	Efficiency	Unit or system efficiency, typical value	Reference conditions and at arithmetic mean of control range limits	14	2.12
4.	Power factor	Typical value	—	14	2.9
5.	Relative harmonic content of source current	Maximum percentage value	Rated conditions; relative harmonic content of source voltage less than 5%	14	2.11.1
6.	Ripple on dc source current	Maximum rms value or peak-to-peak value	Rated conditions; superimposed ripple on source voltage less than 3% rms or 10% peak-to-peak respectively	14	2.11.1

\*Specification for stabilized power supplies, dc output : Part IV Tests other than radio-frequency interference.

†Specification for stabilized power supplies, dc output : Part I Terms and definitions.

**TABLE 4 PERFORMANCE RATINGS — QUANTITIES RELATED TO STEADY-STATE CONDITIONS**

(Clause 3.6)

SL No.	SPECIFIED QUANTITY	SPECIFIED DATA	APPLICABLE CONDI- TIONS	REFERENCE		REMARKS
				Test [ Clause in IS : 7204 ( Part IV )- 1980* ]	Definition [ Clause in IS : 7204 ( Part I )- 1974† ]	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	<i>Load effect</i>	Maximum value, ex- pressed as percentage of the stabilized out- put quantity and/or as absolute value	Rated conditions	3	4.3.3	<i>See Note 1</i>
2.	<i>Source voltage effect</i>	do	do	4	4.3.3	<i>See Note 1</i>
3.	<i>Source frequency effect</i>	do	do	11	4.3.3	<i>See Notes 1 and 3</i>
4.	<i>Temperature effect</i>	do	do	8	4.3.3	<i>See Notes 1, 3 and 5</i>
5.	<i>Temperature coefficient</i>	do	do	8	—	<i>See Notes 1, 3 and 5</i>
6.	<i>Other individual effects</i>	do	do	11	4.3.1	
7.	<i>Combined effects</i>	do	do	12	4.3.3	<i>See Note 2</i>
8.	<i>Total effect</i>	do	do	13	4.9	<i>See Notes 2 and 5</i>
9.	<i>Tolerance band</i>	do	do	13	4.11	<i>See Notes 2 and 5</i>
10.	<i>PARD-Periodic and Ran- dom deviation</i>	Maximum rms and/or peak-to-peak value	Rated conditions; consid- ered frequency range : 20 Hz to 10 MHz	5	4.6	
11.	<i>Drift</i>	Maximum value; time interval and upper frequency limit	Reference conditions; considered frequency range; 0 Hz to 20 Hz; time interval: 8 h	6	4.7	<i>See Note 1</i>
12.	<i>Output capacitance</i>	Nominal value	—	—	5.6.2	
13.	<i>Settling effect</i>	Maximum value; in- fluence quantity sub- jected to change	Rated conditions	10	4.8	<i>See Note 4</i>
14.	<i>Settling time</i>	Maximum value; in- fluence quantity sub- jected to change	Rated conditions	10	4.12	<i>See Note 4</i>

NOTE 1 — Mandatory only if total effect and/or tolerance band are not specified.

NOTE 2 — Mandatory only if load effect, source voltage effect, and either temperature effect or temperature coefficient are not specified. Only Item 8 or 9 is required.

NOTE 3 — Only Item 4 or 5 is required.

NOTE 4 — Mandatory only if the settling effect is not included in the individual effects and/or drift.

NOTE 5 — Mandatory only if it is convenient from the point of view of size and kVA rating.

\*Specification for stabilized power supplies, dc output : Part IV Tests other than radio frequency interference.

†Specification for stabilized power supplies, dc output : Part I Terms and definitions.

**TABLE 5 PERFORMANCE RATINGS — QUANTITIES RELATED TO DYNAMIC CONDITIONS**  
*( Clauses 3.6 )*

SL No.	SPECIFIED QUANTITY	SPECIFIED DATA	APPLICABLE CONDITIONS	REFERENCE	
				Test [ Clause in IS : 7204 ( Part IV )- 1980* ]	Definition [ Clause in IS : 7204 ( Part I )- 1974† ]
(1)	(2)	(3)	(4)	(5)	(6)
1.	Maximum overshoot amplitude	Maximum value; quantity subjected to step change; magnitude and direction of step change	Rated conditions; considered frequency range 0 MHz to 10 MHz	9	5.2.1
2.	Maximum output rate of change	do	do	do	5.4
3.	Transient delay time	Maximum value; quantity subjected to step change; magnitude and direction of step change; width of recovery band, unless equal to corresponding effect band or unless the total effect band or tolerance band serves as recovery band	do	do	5.5.1.1
4.	Transient recovery time	do	do	do	5.5.1.2
5.	Recovery time	do	do	do	5.5.1
6.	Turn-on delay time	Maximum value	Reference conditions	do	5.5.2
7.	Turn-on recovery time	do	do	do	5.5.3
8.	Turn-off decay time	do	Reference conditions; end of decay at 1% of maximum rated value	do	5.5.4
9.	Turn-on ( turn-off ) overshoot	do	Reference conditions	do	5.2.2
10.	Turn-on ( turn-off ) output polarity reversal	do	do	do	5.2.3
11.	Start-up time	do	do	do	4.12.1
12.	Warm-up time	do	do	do	4.12.2
13.	Output impedance	Typical value as a function of frequency	do	7	5.6

\*Specification for stabilized power supplies, dc output : Part IV Tests other than radio frequency interference.

†Specification for stabilized power supplies, dc output : Part I Terms and definitions.

**TABLE 6 PERFORMANCE RATINGS — QUANTITIES RELATED TO CONTROL**

( Clause 3.6 )

SL No.	SPECIFIED QUANTITY	SPECIFIED DATA	APPLICABLE CONDITIONS	REFERENCE	
				Test [ Clause in IS : 7204 ( Part IV )- 1980* ]	Definition [ Clause in IS : 7204 ( Part I )- 1974† ]
(1)	(2)	(3)	(4)	(5)	(6)
1.	Setting range	Maximum value for upper limit and minimum value for lower limit of stabilized output quantity	Limit conditions, if any; otherwise rated conditions	20	4.13
2.	Control range	Minimum value for upper limit and minimum value for lower limit of stabilized output quantity	Rated conditions	do	4.13.1
3.	Discontinuous control resolution	Typical value	Reference conditions, whole control range of stabilized	do	4.14
4.	Incremental control coefficient	do	do	do	4.14.1
5.	Control coefficient	Nominal value	do	—	4.16
6.	Control deviation band	Upper and lower limit values as a function of the control quantity	do	20	4.16.2
7.	Control rate	Maximum value	do	do	4.15
8.	Control time constant	do	do	do	4.15.1
9.	Intrinsic error	do	do	do	4.2.2

\*Specification for stabilized power supplies, dc output : Part IV Tests other than radio frequency interference.

†Specification for stabilized power supplies, dc output : Part I Terms and definitions.

**TABLE 7 PERFORMANCE RATINGS — QUANTITIES RELATED TO LIMIT CONDITIONS**

( Clause 3.6 )

SL No.	SPECIFIED QUANTITY	SPECIFIED DATA	APPLICABLE CONDITIONS	REFERENCE	
				Test [ Clause in IS : 7204 ( Part IV )- 1980* ]	Definition [ Clause in IS : 7204 ( Part I )- 1974† ]
(1)	(2)	(3)	(4)	(5)	(6)
1.	Current limiting threshold	Minimum value: range, if any	setting Limit conditions, if any; otherwise rated conditions except for the unstabilized output quantity	18	7.9.1
2.	Voltage limiting threshold	do	do	do	7.10.1
3.	Maximum limited current	Maximum value; setting range, if any; maximum duration of limiting operation, if other than infinite	Limit conditions, if any; otherwise rated conditions except for the whole setting range for the stabilized output quantity	do	7.9.2
4.	Maximum limited voltage	do	do	do	—
5.	Short-circuit current	do	do	do	7.9.3
6.	Open circuit current	do	do	do	7.10.2
7.	Peak short-circuit current	Maximum value	do	do	—
8.	Peak open circuit voltage	do	do	do	—
9.	Cross-over area	Position and size of the widened load effect band or tolerance band	Rated conditions	do	2.5
10.	Over-current protection	Protective device; reset; typical value for tripping threshold; setting range; tripping margin; tripping delay; overshoot; maximum	Limit conditions if any; otherwise rated conditions except for the unstabilized output quantity	do	7.3
11.	Over-voltage protection	Protective device; reset; typical value for tripping threshold; setting range, if any; tripping margin; tripping delay; overshoot; maximum duration of operation	do	do	7.4
12.	Reverse current protection	Maximum value and duration of voltage and/or reversed current at the output terminals	Rated conditions and non-energized conditions	do	7.7
13.	Reverse voltage protection	Maximum value and duration of current and/or reverse voltage at the output terminals	do	do	7.6

\*Specification for stabilized power supplies, dc output: Part IV Tests other than radio frequency interference.

†Specification for stabilized power supplies, dc output: Part I Terms and definitions.

TABLE 8 PERFORMANCE RATINGS — MISCELLANEOUS

(Clause 3.6)

SL No.	SPECIFIED QUANTITY	SPECIFIED DATA	APPLICABLE CONDITIONS	REFERENCE	
				Test [ Clause in IS : 7204 ( Part IV )- 1980* ]	Definition [ Clause in IS : 7204 ( Part I )- 1974† ]
	(1) (2)	(3)	(4)	(5)	(6)
	1. Isolation voltage	Maximum value; terminals considered	Rated conditions	—	3.6
	2. Insulation resistance	Minimum value; terminals, considered; test voltage	Non-energized condition	—	3.5
	3. Insulation test voltage	Maximum (rms) value duration		—	3.5.1
13	4. Capacitance to source	Maximum value; terminals considered		15	3.4.1
	5. Capacitance to frame	do		16	3.4
	6. Common mode current	Maximum value; terminals considered	Reference conditions	17	3.7
	7. Sound level	A-weighted sound level (see IS : 3932-1966†) maximum value; location of microphone	Rated conditions	19	—
	8. Electromagnetic interference emanation	Under consideration	Under consideration	IS : 7204 ( Part III )- 1980§	—
	9. Cooling medium temperature	Maximum value of temperature rise of cooling medium	Rated conditions	—	3.2

\*Specification for stabilized power supplies, dc output : Part IV Tests other than radio frequency interference.

†Specification for stabilized power supplies, dc output : Part I Terms and definitions.

‡Specification for sound level meters for general purpose use.

§Specification for stabilized power supplies, dc output : Part III Radio frequency interference test.

## **5.2 Mass**

**5.2.1** List the total mass including all parts attached to the power supply during normal operation. In the case of fluid-filled units, this includes the fluid.

**5.2.2** The component layout of the stabilized power supply unit should be such that the average floor loading does not exceed 1 000 kg/m<sup>2</sup>.

**5.3 Mounting Position** — If this position is not obvious from construction and if it is required that the power supply be mounted in a specified manner, an arrow pointing 'up' shall be marked on a vertical surface.

**5.4** The circuit diagram of the unit may also be supplied by the manufacturer.

## **6. MARKING**

**6.1** The following information shall be permanently affixed to the power supply:

- a) Name of manufacturer or supplier;
- b) Model number;
- c) Serial number ( optional );
- d) Output ratings: rated values or rated ranges of values for output voltage and current;
- e) Input ratings: nominal values for source voltage, source current and frequency, number of phases;
- f) Protection class in accordance with the relevant Indian Standard; and
- g) Mass ( optional ).

**6.1.1** Each power supply may also be marked with the ISI Certification Mark.

**NOTE** — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution ( Certification Marks ) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

## 7. TESTS

**7.1** Unless otherwise agreed between the manufacturer and the user, the tests specified in this clause shall normally be carried out at the manufacturer's works. For details of test methods, reference may be made to IS : 7204 ( Part IV )-1980\*. The method of test for radio frequency interference is given in IS : 7204 ( Part III )-1980†.

### 7.2 Classification of Tests

**7.2.1 Type Tests** — The following shall constitute the type tests:

- a) Output impedance,
- b) Temperature effect,
- c) Other individual effects,
- d) Combined effects,
- e) Total effect,
- f) Capacitance to source terminals,
- g) Capacitance to frame,
- h) Measurement of common-mode ( leakage ) currents,
- j) Sound level measurement,
- k) Control effect, and
- m) Radio frequency interference.

**7.2.2 Routine Tests** — The following shall constitute the routine tests:

- a) Load effect,
- b) Source effects,
- c) PAR<sub>D</sub>,
- d) Drift,
- e) Transient performance measurement,
- f) Settling effect,
- g) Measurement of quantities related to source,
- h) Boundary condition measurement,
- j) Isolation voltage,
- k) Insulation resistance, and
- m) Insulation voltage.

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\*Specification for stabilized power supplies, dc output: Part IV Tests other than radiofrequency interference.

†Specification for stabilized power supplies, dc output: Part III Radiofrequency interference tests.

# **INDIAN STANDARDS**

**ON**

## **POWER CONVERTORS**

**IS:**

1885 ( Part XXVII )-1969 Electrotechnical vocabulary : Part XXVII Static power convertors

2511-1963 Polycrystalline semiconductor rectifier stacks

3136-1965 Polycrystalline semiconductor rectifier equipment

3895-1966 Monocrystalline semiconductor rectifier cells and stacks

4540-1968 Monocrystalline semiconductor rectifier assemblies and equipment

6619-1972 Safety code for semiconductor rectifier equipment

7204 ( Part I )-1974 Stabilized power supplies, dc output : Part I Terms and definitions

7204 ( Part II )-1980 Stabilized power supplies, dc output : Part II Rating and performance

7204 ( Part III )-1980 Stabilized power supplies, dc output : Part III Radio frequency interference tests

7204 ( Part IV )-1980 Stabilized power supplies, dc output : Part IV Tests other than radio frequency interference

7728-1975 Single-phase traction power convertors

# INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

## Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

## Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

## Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	1 N = 1 kg.m/s <sup>2</sup>
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m <sup>2</sup>
Frequency	hertz	Hz	1 Hz = 1 c/s (s <sup>-1</sup> )
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m <sup>2</sup>

## INDIAN STANDARDS INSTITUTION

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones : 26 60 21, 27 01 31

Telegrams : Manaksantha

### Regional Offices:

Western : Novelty Chambers, Grant Road  
 Eastern : 5 Chowringhee Approach  
 Southern : C. I. T. Campus, Adyar

BOMBAY 400007	37 97 29
CALCUTTA 700072	27 50 90
MADRAS 600020	41 24 42

### Branch Offices:

'Pushpak', Nurmohamed Shaikh Marg, Khanpur  
 'P' Block, Unity Bldg, Narasimha Rao Square  
 Gangotri Complex, Bhadbhada Road, T. T. Nagar  
 22E Kalpana Area  
 Ahimsa Bldg, SCO 82-83, Sector 17C  
 5-8-58C L. N. Gupta Marg  
 D-277 Todarmal Marg, Banipark  
 117/418 B Sarvodaya Nagar  
 Patliputra Industrial Estate  
 Hantex Bldg ( 2nd Floor ), Riy Station Road

AHMADABAD 380001	2 03 91
BANGALORE 580002	2 76 49
BHOPAL 462003	6 27 16
BHUBANESHWAR 751014	5 36 27
CHANDIGARH 160017	2 83 20
HYDERABAD 500001	22 10 83
JAIPUR 302006	6 98 32
KANPUR 203005	8 12 72
PATNA 800013	6 28 08
TRIVANDRUM 695001	82 27